



International Institute for
Applied Systems Analysis
Schlossplatz 1
A-2361 Laxenburg, Austria

Tel: +43 2236 807 342
Fax: +43 2236 71313
E-mail: publications@iiasa.ac.at
Web: www.iiasa.ac.at

Interim Report

IR-11-006

Methodological Approach to the Study of Sustainable and Safe Social and Economic Development of the Territories

Oleg I. Nikonov (aspr@mail.ustu.ru)

Vadim V. Krivorotov (esec@mail.ustu.ru)

Alexei V. Kalina (alexkalina74@mail.ru)

Approved by

Arkady Kryazhimskiy (kryazhim@iiasa.ac.at)

Leader, Advanced Systems Analysis Program

August 2011

Foreword

The problems of social and economic development of the country under conditions of the world financial crisis are discussed in the paper. Methodological basics are proposed for the research of sustainable and safe social and economic development (SSSED) of the territories of different levels. Major components in the scheme of research of SSSED are characterized. For the territories of the regional level a methodological approach to differentiate SSSED is proposed and discussed. Algorithms evaluating the state of the economy from the viewpoint of providing SSSED and from the viewpoint of the indicators of sustainability of the direction of social and economic development are also proposed. An example of the use of elaborated methodological tools as applied to the state and forecasting of the indicators of the Ural Federal Region territories SSSED is given.

Contents

1	Introduction: Problems of sustainability of social-economic development of Russia and some other countries at the present stage	1
2	Foreign and domestic research experience of sustainable development problems	2
3	Methodological approach to study of sustainable and safe social and economic development of the territories of different level	4
4	Indicative analysis as a tool for diagnostics of sustainable and safe social and economic development of the territories	6
5	Application of the methodological and model instruments to the territories of the Ural Region	11
	References	17

List of Figures

1	GDP growth dynamics of the world leading economies in 2000-2009	2
2	Life expectancy at birth in 2007-2008 in Russia and other leading countries of the world	3
3	Complex evaluation of sustainable and safe development in the subjects comprising the Ural Federal Region in 2000-2007	11
4	The scheme of research of SSSED of the territories of different levels	16

Acknowledgments

The research is partially supported by the Russian Fund of Basic Research (Grants 09-01-00223a and 11-06-00153a) and by the Program of Basic Research of the Presidium of the RAS “Mathematical Control Theory” supported by URO RAS, Project 09-P-1-1014.

About the Authors

Oleg Nikonov is the Dean of the faculty of Information and mathematical technologies and economic modeling, Head of the department “System Analysis and Decision Making”, Dr.Sci (mathematics), professor at the Ural Federal University, Ekaterinburg.

Vadim Krivorotov is the Dean of the faculty of Economics and management, Head of the department “Economic Safety”, Dr.Sci (economics), professor at the Ural Federal University, Ekaterinburg.

Alexei Kalina is a Cand.Sci(engineering), the associate professor of the department “Economic Safety ” at the Ural Federal University, Ekaterinburg, Russia.

Methodological Approach to the Study of Sustainable and Safe Social and Economic Development of the Territories

Oleg I. Nikonov (aspr@mail.ustu.ru)

Vadim V. Krivorotov (esec@mail.ustu.ru)

Alexei V. Kalina (alexkalina74@mail.ru)

1 Introduction: Problems of sustainability of social-economic development of Russia and some other countries at the present stage

The world economic crisis has demonstrated that the economic growth in Russia had not been of sustainable character and had been mainly stipulated by high oil prices at the world raw materials market. Considerable decrease in these prices has lead to a shift in direction of the development of the Russian economy. It has been reflected in the setback in production, as well as in the problems connected with the liquidity of banking system; in the difficulties of large Russian enterprises facing maintenance of the external debt; in the substantial decrease of the income level of a considerable part of the population; in rapid unemployment growth and many other unfavorable trends. For example, in 2009 the decrease in GDP in Russia amounted to 7,9%. At the same time industrial production which is the “engine” of the development of the majority of other branches of economy decreased by 11% and in some regions it even dropped by 15 – 25%. In other words, within a very short period of time the Russian economy changed from being one of the fastest-growing to one of the “fastest-falling” which demonstrates that its development was unsustainable. If data about the GDP growth in Russia and world leading economies are compared (Fig. 1; Source: Russian Federal Statistic Bureau), one can see that the Russian economy is characterized by the highest fluctuations and highest GDP in 2009.

On the other hand, it is impossible to say that the development of Russia during “safe” periods (2000 upwards) was of a stable nature. Data characterizing the state of the social sphere and demographic processes say the contrary. For example, in the demographic sphere beginning from 1992 the country suffers constant population decrease. According to the results of the year 2009, natural growth in population amounted to (-1,8) persons per every 1000 citizens or (-249,4) thousand persons in absolute figures. The country has a relatively low average life interval especially if compared with the world leading states (Fig. 2).

The data provided supports the idea that the problem of sustainable and safe social and economic development (SSSED) being one of the major tasks which any government may face is as urgent for Russia at the current stage as for many other world economies.

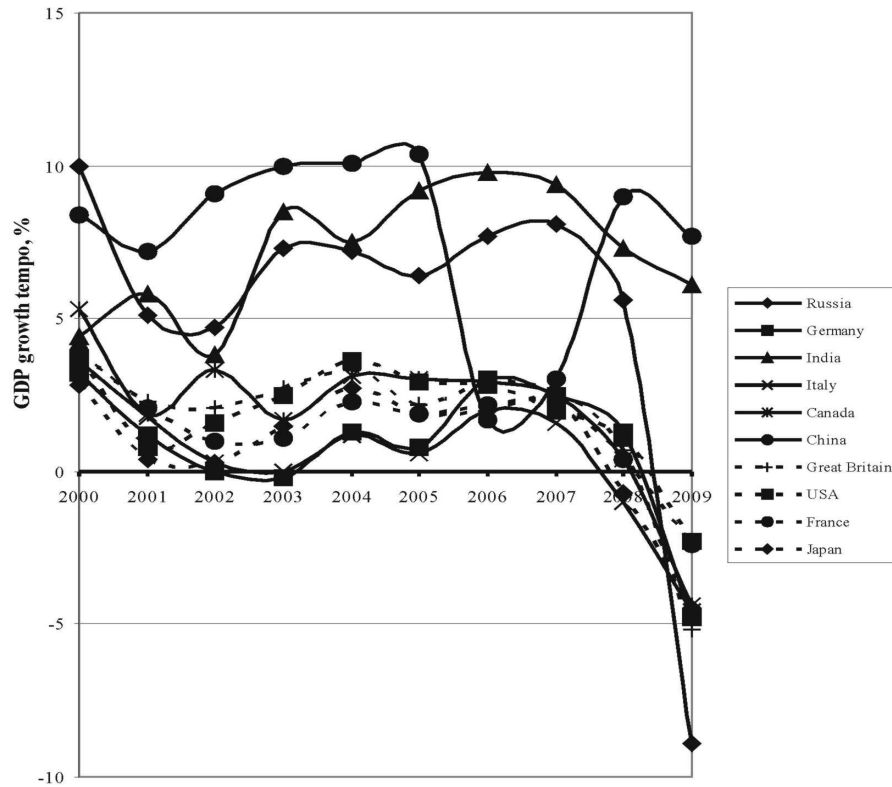


Figure 1: GDP growth dynamics of the world leading economies in 2000-2009

2 Foreign and domestic research experience of sustainable development problems

Until recently this problem was mainly considered at the global intergovernmental level and preservation of balance between human beings and natural environment has been one of the main priorities. Thus the main stipulations of the concept of sustainable development were presented at the UN conference about the environmental protection and development in Rio de Janeiro by the Gro Harlem Brundtland commission. The notion of sustainable development was understood as the development under which all the current needs are satisfied without infringing or threatening the rights of the coming generations for such possibilities [1].

According to the opinion of V.I. Danilov–Danilyan “sustainable development is such a state under which natural basis is not destroyed, created life conditions do not lead to human degradation, and social-destructive models do not reach the scale threatening society safety” [2,3].

The notion of sustainable development was first formulated and applied to economics by John Hartwick in the 1970s. The rule of Hartwick says that it is possible to provide sustainable development if the whole rent is coming from natural resources and defined as the difference between market price of the natural resources and costs of its produce is invested into the reproduced capital [4 – 7].

Among other basic concepts of sustainable development of the economy the theory of maximum flow of aggregated income by Hicks-Lindal should be pointed out. This income

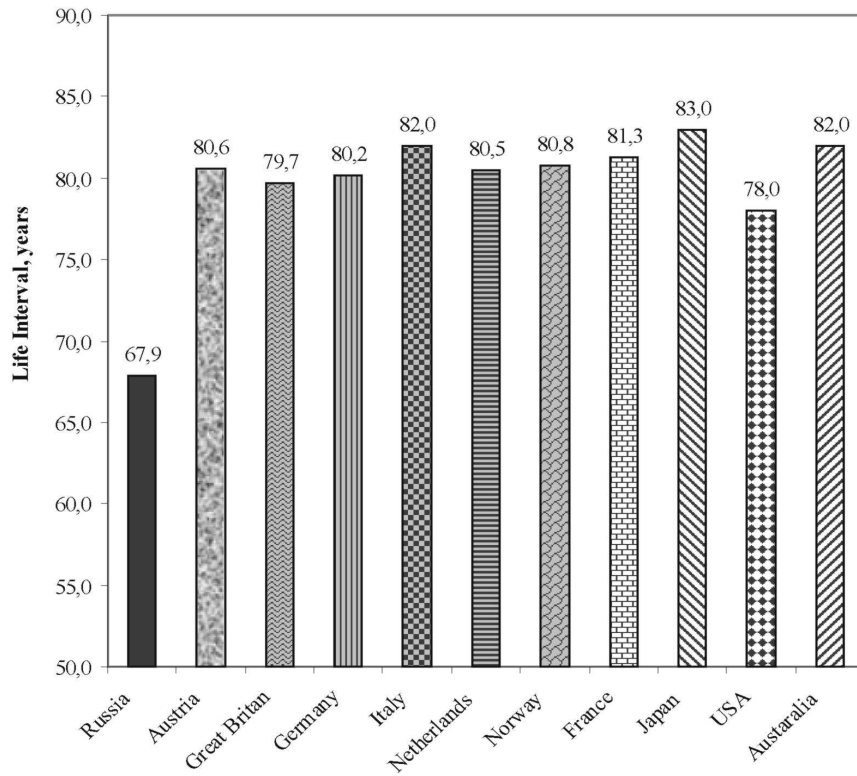


Figure 2: Life expectancy at birth in 2007-2008 in Russia and other leading countries of the world

may be received only under the conditions of preservation of the aggregated income with the help of which this income has been produced. This concept implies optimal use of limited resources and application of ecological nature-, energy-, and material-saving technologies, including extraction and processing of raw materials, creation of ecologically acceptable produce, minimization, processing and deletion of wastes [4].

One should remember that the above-mentioned approaches along with the majority of other approaches aimed at providing sustainable development (including economic sphere) may be characterized as “global” and long-term. Thus they are not suitable from the viewpoint of market regulation processes and when taking current measures aimed at reaching targets of sustainable and safe social and economic development. Moreover, these approaches require serious adaptation measures if applied to management of SSSSED of the territories of the regions and smaller territorial structural units. That is why a task to research and manage SSSSED of the territories of different levels appears. The basis for this research and management should be formed by modern economic realities and aimed both at reaching global targets of sustainable development (as explained above) and at reaching private targets of sustainable development in relatively short time frames (3, 5, 10 and more years). These last targets depend a lot on the economic situation and recent trends of its development.

The research of the Russian scholars devoted to the problem of SSSSED of the domestic economy has mainly been about provision of economic safety of the country. The basic works in this sphere are those by V. Senchagov [8, 9], S. Glazyev [10], E.Oleinikov [11],

A. Tatarkin [12, 13], I. Bogdanov [14], plus a number of other Russian scholars. Keeping these works in mind and taking into consideration their own research experience, the authors of this article come forward with their own definition of economic safety of the territory. Economic safety of the territory is defined as such a state of the territorial economy under which there always is some possibility to preserve acceptable levels of criterial indicators - the indicators of the economic safety - which are chosen in advance. The economic system should be capable of reacting at arising internal and external threats without avalanche-like development of the crisis processes; at the same time the conditions of SSSSED and reproduction are created [15].

3 Methodological approach to study of sustainable and safe social and economic development of the territories of different level

The issues connected with the formation of theoretical and methodological basics to research SSSSED of the territories remain almost untouched. In our opinion, SSSSED of the territory is the ability of the economic system of a certain territory to preserve sustainable positive dynamics and direction of the development of the main social and economic indicators without sharp leaps and fluctuations. It is also the ability to reach in the course of its development satisfactory indicators of the level of economic safety and to support balanced development of different spheres of business activity at the territory without “preferences” of some particular spheres. The ultimate target of SSSSED of the territory is constant growth of welfare and improvement of the quality and conditions of life of the population of the territory [15].

It is well-known that social and economic systems are always at the unstable equilibrium point, as it tends to develop system economic crises and to turn from sustainable to unsustainable state even under minor disturbances. In many cases such disturbances are outside the economic system and are connected with the political situation in certain regions of the world or in certain countries.

Instability of modern social and economic systems is investigated and proven in the work of I. Prigozhin (a Nobel Prize laureate in 1977). His research is based on the idea that modern reality is characterized by disorder, instability, non-equilibrium, non-linear relations, where a small signal at the entrance may cause whatever strong response at the exit. Moreover, under certain conditions insignificant changes may lead to system “overthrow” [16 – 17].

In this connection the only way to provide SSSSED of the states and their regions as understood by the authors of the present paper is to constantly regulate the basic criterial indicators - features of SSSSED and to support their value within given limits. Thus the major tasks are the formulation of a complex of such indicators and definition of allowed limits of their change which will not disturb stability; the evaluation of sustainability of the direction of social and economic development of the territory taking into consideration different variants of deviations of indicators from the set limits due to different scenarios of external conditions development; evaluation of the results of state regulation measures taken to neutralize crisis displays hampering SSSSED; as well a number of other tasks. The overall scheme of research of SSSSED of the territories of different levels is exemplified in Fig. 4 (p. 16).

While researching SSSSED as applied to the conditions of the Russian Federation four major territorial levels are singled out in accordance with the system of federative structure of the state and territorial hierarchical structure forming the authoritative bodies:

1. The federal level (the level of state as a whole). At this level the object of research is the Russian Federation as a united independent state which is characterized by a set of national state macroeconomic indicators and features.

2. Subregional level. Here the objects of research are federal regions (federal okrugs) as unities of several subjects of the Russian Federation according to the geographical principle.

3. Regional level. The objects of research are the subjects of the Russian Federation as territorial units having their own authorities in the sphere of economics and are responsible for their own economic policy within the frames of the federal one.

4. Municipal level. This level is the lowest one and is the least economically independent subject of research. Management of sustainable and safe development and economic safety at this level is mainly related to solving national and regional tasks as local bodies of government have limited power in solving social and economic tasks. It is very often that the development of the territories of municipal level is connected with the development of economy forming enterprises operating at a given territory.

As is clear from Fig. 4, the overall scheme of SSSSED of the territories of different levels includes the following basic units:

1. Theoretical. Here the theoretical basics and logical scheme of research of SSSSED are provided.

2. SSSSED diagnostics. It is conducted according to a set of indicators grouped together along the types of activity at the territories. The ultimate target of this unit is the evaluation of the state of economy of the territory and the state of the indicators of sustainability of the direction of social and economic development.

3. Unit of latent characteristics of social and economic processes and displays. Here understanding of the real scale of separate social and economic processes and displays not seen by the system of statistical analysis is achieved. The basis of such definition is the application of special mathematical methods together with the data of sociological, epidemiological and other researches as well as expert evaluations.

4. Unit forecasting SSSSED indicators. It includes certain procedures, algorithms and approaches to modeling and forecasting SSSSED indicators. Here it is suggested to use economic and statistic methods, methods of mathematical theory of control and estimation, methods of multi-criteria optimization, and approaches and methods of the theory of decision making, the mathematical model of competition life cycle as basic for modeling and forecasting.

5. Unit of innovational development (ID). It is one of the central units in the system of modeling as it defines the state and direction of the innovational sphere at the territory. First and foremost, such development is connected with stage by stage implementation at the territories of “critical technologies” which in turn serve as a basis for science and technical progress (STP).

6. Unit evaluating the results of conducted work and program-target measures. The effectiveness of program-target measures to neutralize (minimize) the threats of social and economic development of the regions of the Russian Federation in the direction of preservation (recovery) of sustainable development is evaluated in this unit. It is particularly planned to work out methodology analyzing deviations of the existing figures from the planned ones and to define the elasticity coefficients of influence of certain measures on the indicators of SSSSED.

Summarizing the characteristics of the unit structure of SSSSED research it should be noted that one of its most important units is the unit of diagnostics. In this unit the methodological basis of research is formulated, the system of criterial indicators of the

degree of achieving the demands of SSSED in different directions of activity is formed, the main threats and “narrow places” in the economic systems of the territories are defined that, on the one hand, allows making judgments about stability of the direction of social and economic development, and on the other hand, serves as the basis when taking measures to neutralize threats.

4 Indicative analysis as a tool for diagnostics of sustainable and safe social and economic development of the territories

The indicative analysis is used by the authors of the present paper as the basis for SSSED of the territories diagnostics. In essence, it comes down to the following: SSSED diagnostics is conducted relying on a set of criterial indicators - SSSED indicators, each characterizing this or that aspect or possible threat. Here all the indicators are grouped together to form certain units. It is done so because of the scope of the tasks set and because many features are analyzed while examining SSSED. Nine major units are singled out which in turn are further analyzed within two directions:

1. Provision of stability of functioning and sustainable development of production and financial sphere. It is further subdivided into 4 indicative units:

- 1.1. The unit of investment processes and capital reproduction stability.
- 1.2. The unit of production and scientific and technological potential.
- 1.3. The unit of financial sustainability.
- 1.4. The unit of reliability and continuity of energy and power supply.

2. Provision of decent conditions of life and population reproduction. Here five indicative units are singled out:

- 2.1. The unit of the level of life and financial well-being of the population.
- 2.2. The unit of labour potential and situation at the labour market.
- 2.3. The unit of population growth and sustainability of demographical processes.
- 2.4. The unit of law and order and intensity of the criminal situation.
- 2.5. The unit of food provision and food security.

At the moment the system suggested contains more than a hundred indicators.

It should be mentioned that the systems of indicators characterizing sustainable development including that of social and economic spheres have been used since the 1970s. The World Bank is one of the leaders in working out criteria of sustainable development. The World Bank publishes its annual report “The indicators of the world growth”. This system is in reality a complex of basic macroeconomic indicators, indicators of natural resources consumption and the environment situation, as well as basic indicators characterizing social and demographic spheres which are defined for every country [18].

The factors of sustainable development which are monitored by UNO are also worth mentioning. The index of human potential development (HPDI), index of life quality and security, the index of human development, the index of ecological measurements, the index of economic management deserve to be mentioned [6, 19].

Still, one should remember that the indicators used by the World Bank, UNO or other international organizations are of extended global character and are more suitable when evaluating the directions of country development and conducting cross-country comparisons. Thus, such systems of indicators are not very efficient if applied to working out programs and measures providing SSSED of the countries and territories of any hierarchical level which may comprise it. So the task being solved demands a “practical” system of indicative indicators which, on the one hand, would help to draw a simple conclusion

about the state of SSSSED and its changes in a certain territory. On the other hand, it is possible to define directions and to form the system of measures units aimed at prevention of SSSSED threats and neutralizing their negative consequences.

It is worth noting that from the view-point of sustainable social and economic development it is important to know not only the current value of the indicative indicator but also the ability of the economic system to support stable levels of sustainability along some particular criterion (or group of criteria) within a certain integral period (3, 5 or more years). The following levels of importance of indicators of social and economic development and integral periods to calculate the abovementioned indicators are suggested:

1. Stability in the short term. Traditionally one year is meant here (the value of the indicator is that at the end of the reported year) or sometimes even shorter periods (such as half-year, quarter, month). From the view-point of evaluation of sustainability of direction of social and economic development it is not very informative. The evaluation of SSSSED of the territory is to solve the following tasks:

- To characterize the state of the economy at a certain period of time from the view-point of meeting the demands of SSSSED and the degree of influence of some particular threats;
- To define the dynamics of system as compared to the previous periods and to evaluate the effectiveness of target measures aimed at neutralizing (localizing) threats of SSSSED and taken in the current or previous period.

2. Stability in the mid term. As a rule such a term amounts to 5 years. Sometimes, though, for some dynamically developing spheres 3 years may be understood as a mid-term period. To conduct the diagnostics of SSSSED average indicators of the analyzed integral period are taken. The evaluation of SSSSED from the point of view of stability of the ongoing processes is more informative as compared to the results of the short-term period. In reality they shape the direction in which the economic system will move in the long-term period. If the process of dynamic change of the indicator has fluctuating character, all the levels of stability in the short-term period are going to be relatively low in spite of their high results of some particularly analyzed short-term periods.

It should also be added that for a number of indicative indicators the evaluation of the situation is limited to short-term and mid-term periods because of the influence of the factors defining the change of the indicators, the periods of cyclic or irreversible changes, and the economic essence of the indicators.

3. Stability in the long term. Average integral value of an indicator within 10 years is understood as a long-term period. It is no use considering even longer periods as cyclic changes of external conditions for the state as a whole and its certain regions, take place within such periods. From the viewpoint of stability SSSSED indicators of the long-term periods characterize the direction of the system development within a long economic cycle. Very often such indicators have the highest level of importance regarding SSSSED provision.

As is clear from Fig. 4, while analyzing SSSSED two groups of indicators are defined: indicators of the state of economy and of sustainability of social and economic development.

The evaluation of the state of the economic system in the short-, mid- and long-term is conducted according to a whole set of indicators. From the viewpoint of the current state of economy the results of evaluation of one and the same indicator in different periods are understood as having equilibrium value without any priority attributed to any of them.

Each of the indicators is classified according to the level of stability (classes of state) from the viewpoint of SSSSED provision:

- High. This level is characterized, on the one hand, by the value of indicative indicators which correspond to the generally accepted norms of certain economic processes

and displays, and, on the other hand, by a higher “safety factor” (more than 20 – 30%) in relation to the point of possible instability. Note that through the whole period the indicators with high level of stability do not enter the state of instability though, at times, they may border such states. Summing it up, we may come to the conclusion that states with high levels of stability should serve as standard to be striven for;

- Sufficient. This level indicates preservation of stability in processes and displays which are characteristic for the analyzed factor. At certain stages of mid- and long-term periods the situation may cross the border and enter the states threatening to disturb the indicator under consideration, but the time within which the system remains in such a state is relatively short (as a rule, not longer than 1 or 2 years). The state of sufficient stability as opposed to the state of high stability is characterized by a lower “safety factor” of the economic system relating to the negative displays of the possible threats. All in all, the state of sufficient stability may be understood as favorable for SSSSED of the territory;

- Low. This state is characterized by constant disturbances of stability in the direction of social and economic development in short term as well as in mid- and long-term periods. Here the dynamics of the indicator change, as a rule, tend to fluctuate. In such conditions the development of the system is under threat and normally appears to be distorted. If a system remains in such a condition for a long time, complete stability disturbance is possible and negative social and economic consequences may be expected, some of them which may even be irreversible. It is often very inexpensive for the system to reach the state with a higher level of stability. Under favorable circumstances (external conditions of development, market situation, etc.) the system is capable of returning to such states without any special regulatory interference;

- Unacceptable. This is a state where SSSSED of the territory is completely disturbed. The direction of the system development leads to further accumulation of negative consequences with every passing year. In this state the targets of long-term development become only of second importance giving way to the tasks of “survival” of social and economic systems under conditions of strong impact of threats and negative trends. It is very expensive to take the system out of such a state - help from outside and mobilization of internal resources is required. If a system is in such a state, efforts should be taken to bring it to the states with higher levels of stability. The longer the system remains in such a state, the more irreversible the negative trends become for its further development.

The following stages may be singled out in the process of economic state evaluation from the viewpoint of meeting the requirements of SSSSED:

1. Receiving the evaluation of the state according to some particular SSSSED indicators.

Such evaluations result from the comparison of the current value of SSSSED indicators with their critical value. The main problem of the stage is to reliably define threshold value of indicative indicators under which the error would be minimum. The following methods and approaches are supposed to be used to define the threshold value of indicative indicators:

- 1) the method of expert evaluation;
- 2) the application of the indicators of the developed countries;
- 3) the value of a number of indicators may be regulated by law;
- 4) the application of the special mathematical tools. However the majority of methods originally rely on the opinion of experts and the result quite often correlates to the opinion of experts.

Attention should be paid to the threshold zones to define which ones are between the levels of sufficient and low efficiency and low and unacceptable zones. It is very complicated to define the border between the levels of high and sufficient stability as it is understood

that both of these states are not violating SSSSED. In this respect the threshold border dividing these zones is set based on the assumption that the zones of sufficient and low stability are equal, i.e. the threshold value dividing these zones is summed up with (or is deducted from) the difference between the threshold value of the zones with low and unacceptable stability.

2. Receiving the value of the state according to the indicative unit.

To receive the evaluation, a well-known procedure of indicators rate setting is performed. The main targets of rate setting are the transfer of all the values of the indicators into a universal system of measurements and provision of comparability of different indicators. Rate setting occurs in relation to the zone situated between high and unacceptable stability using the following algorithm:

$$\left\{ \begin{array}{ll} \text{If } x_i > x_{S,i} \text{ and } x_{S,i} > x_{IA,i}, & \text{then } x_i^* = 0, \\ \text{if } x_i < x_{S,i} \text{ and } x_{S,i} < x_{IA,i}, & \text{then } x_i^* = 0, \\ \text{if } x_i < x_{S,i} \text{ and } x_{S,i} > x_{IA,i}, & \text{then } x_i^* = \frac{x_{S,i} - x_i}{x_{S,i} - x_{IA,i}}, \\ \text{If } x_i > x_{S,i} \text{ and } x_{S,i} < x_{IA,i}, & \text{then } x_i^* = \frac{x_i - x_{S,i}}{x_{IA,i} - x_{S,i}}, \end{array} \right. \quad (1)$$

where x_i is the value of i indicator of SSSSED in the original system of units;

$x_{S,i}$, $x_{L,i}$, $x_{IA,i}$ are the corresponding threshold values of sufficient, low and insufficient levels of stability for i indicator of SSSSED in the original system of units;

x_i^* – fixed value of i indicator of SSSSED.

It is very easy to see from the equation (1) that in the fixed rate system of units all the indicators characterized by high levels of stability have zero value, and the value of the ones characterized by unacceptable level exceeds “1”. The borders (threshold levels) of some certain states according to the level of stability come to the following figures: for sufficient level – “0”; for low level – “0,5”; for unacceptable level – “1”.

Such a way of rating the value of indicators was used in diagnostics of economic safety and its components [13]. The evaluation of the level of stability according to indicative units (synthetic indicators) is defined as below:

$$F_j = \frac{\sum_{i=1}^n \alpha_i \cdot b_i \cdot x_i^*}{\sum_{i=1}^n \alpha_i \cdot b_i} \quad (2)$$

Where F_j is the evaluation of the level of stability according to j indicative unit;

α_i – weighting coefficient of the importance of i indicator of SSSSED within j indicative unit. Usually the value of α_i is set in an expert manner if the equation $\sum_{i=1}^n \alpha_i = 1$ is true.

However in practice all the indicators tend to be equilibrium;

b_i – weighting coefficient taking into consideration the level of stability of of the state basing on i indicator of SSSSED. It is set from the following assumption: the lower the level of stability of the state, the higher b_i , as in this case the consequences of SSSSED disturbance have a more irreversible character;

n – the number of indicators comprising j indicative unit.

While evaluating the state of SSSSED according to indicative units the threshold levels correspond to set rate threshold levels in some certain indicators. Complex evaluation of the state of economy of the territory according to the level of stability of SSSSED is conducted in a similar way.

There are a lot of approaches in literature to calculate stability indicators or their temporal oscillations. To be more precise, one may find recommendations in the works

of Afanasiev V.N. and Yuzbashev M.M. [20, 21], Tchetverikov N.S. [22], Rasutina A.E. and Kunitsina N.N. [23] and others. In the majority of works stability is understood from the point of view of “fluctuations amplitude” of the indicator in the process of its change with time. Basing on the above-mentioned works the authors single out the major indices evaluating the stability of the direction of the social and economic development.

1. Stability index of the direction of social and economic system development.

Its definition is directly connected with fixed rate evaluation of the indicators received before. For certain indicators this index may be expressed in the following way:

$$\Delta x_i^{mt} = x_i^* - x_i^{*(t-m)}, \quad (3)$$

where t is year (period) for which the index is calculated;

m – temporal period aggregated in the value of the indicator (reference to the period is contained in the name of the indicator). Normally $m = 1$ for a short term period, $m = 5$ for a midterm one and $m = 10$ for a long term.

It is also supposed that if $\Delta x_i^{mt} < 0$ then it denotes the direction of growth (recovery) of the level of stability; $\Delta x_i^{mt} \approx 0$ – denotes the situation when the level remains unchanged; while $\Delta x_i^{mt} > 0$ speaks about level decrease (the higher is Δx_i^{mt} , the greater is the possibility of sustainable development disturbance).

Calculation of stability index for indicative units as well as for complex evaluation of SSSSED of the territories is done according to the following formula:

$$\Delta F_j = \frac{\sum_{i=1}^n h_i \cdot k_i \cdot \Delta x_i^{mt}}{\sum_{i=1}^n h_i \cdot k_i}, \quad (4)$$

where h_i – weighting coefficient considering temporal period which is aggregated in the value of the indicator. The longer the period, the more important is the indicator from the viewpoint of evaluation of stability of development and the higher should be the value of h_i for such an indicator; k_i – weighting coefficient considering irreversibility of the consequences under high tempo of instability development. When $\Delta x_i^{mt} < 0,5$ (the directions of preservation or increase of the level of stability, and the direction of decrease of the level of stability but not more than for one state of stability zone) $k_i = 1$; when $0,5 \leq \Delta x_i^{mt} < 1$ $k_i = 2$; when $\Delta x_i^{mt} \geq 1$ $k_i = 3$.

The value of h_i depends on the temporal period for which the indicator is calculated and is received through the following equation:

$$h_i = \sum_{t=1}^m \frac{1}{t}. \quad (5)$$

It is easy to understand that if $m = 1$ the value is $h_i = 1$; if $m = 5$ – $h_i \approx 2,283$; if $m = 10$ – $h_i \approx 2,929$. Such method of calculating attributes more importance to later periods and less importance to earlier ones.

2. Fluctuatability of development index.

This index is only defined on the basis of the indicators of the short term and characterizes the mid-term period within which the change of direction of development of the index occurs. Every change of the sign Δx_i^{mt} or ΔF_j is considered to be the change of direction (while calculating indices for indicative units or complex indicator of the level of stability of social and economic development). A formula is used:

$$g_i = \frac{T}{S_i}, \quad (6)$$

where g_i – index of fluctuatability of development;

S_i – frequency of changes of social and economic development according to i indicator (indicative unit) of SSSED within the period under discussion T .

The bigger is the value of g_i , the more stable is the direction of social and economic development. At the same time, when $S_i = 0$, the calculations are not conducted and the direction of development is understood to be stable. However the direction of such development should be taken into consideration as it may be stably negative.

5 Application of the methodological and model instruments to the territories of the Ural Region

The methodological approach suggested in the present article has been applied to the evaluation of sustainable and safe development of the social sphere in the subjects comprising the Ural Federal Region (UrFO, Ural Federal Okrug). The period analyzed is 2000 – 2007. The results of the research are represented in Fig. 3 [24].

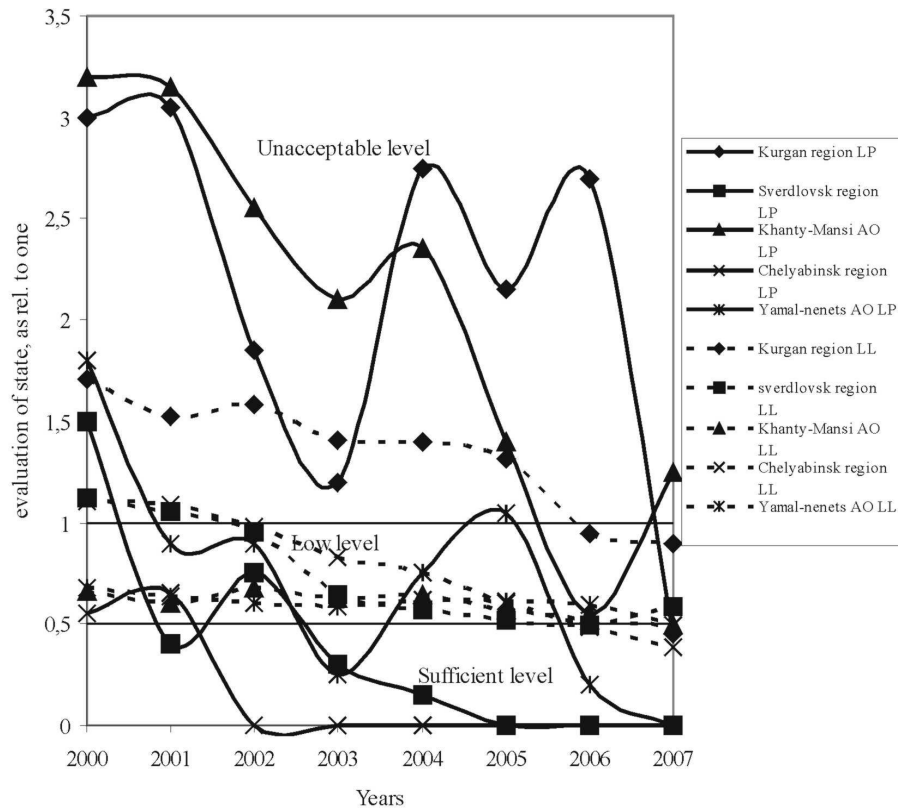


Figure 3: Complex evaluation of sustainable and safe development in the subjects comprising the Ural Federal Region in 2000-2007

Here LP is the unit of labour potential and situation on the labour market; LL – the unit of life level and financial well-being of the population. The main indicators for the calculations (in the majority of cases the value of the indicators was defined for the time being, as averaged in 5 years and in 10 years) are:

In the unit of life level and well-being of the population:

- share of the population with the income below the subsistence level in the total population size;
- relation of average capital income per capita to subsistence level;
- relation of average pension size to the subsistence level of the pensioners;
- relation of average income level of 10% of the most highly-yielding layers of population to the average income of 10% of the least-yielding part of the population (coefficient of funds);
- total area of available housing per capita;
- total area of available housing with amenities per capita;
- amount of flats per one citizen of working age and older;
- degree of housing availability.

In the unit of labour potential and situation at the labour:

- general level of unemployment;
- relation of the number of registered unemployed to the demand for workers about which the state bodies involved in population employment issues are informed by different companies and businesses;
- relation of those involved in economic relations to the total population;
- share of foreign citizens and persons without citizenship in the total amount of those involved in economic relations.

Briefly summarizing the results, the following should be said:

1. There are still territories with high levels of population living behind the poverty level. Here we mention the Kurgan region first as, in 2007, more than 20% of the population had an income below subsistence level.

2. In all the territories the housing situation leaves a lot to be desired. At present, the total area of available housing with amenities per capita does not exceed 16 m²/person in any of the territories of the Ural Federal Okrug and in the Kurgan region it is less than 10 m²/person.

3. In many regions there is a high differentiation of income, especially in the richer ones. Coefficient of funds in Sverdlovsk region, Khanty-Mansi and Yamal-Nenets autonomous regions at the end of 2007 exceeded 18 times.

4. Among the main positive results, a relatively low level of unemployment should be mentioned in all the territories of UrFO (according to the results of 2007 it did not exceed 8%). In 2000 this indicator in all the territories was very close to or exceeded 10%.

5. In spite of the fact that in recent years practically all the territories have demonstrated stabilization, and positive trends of development of the situation in the social sphere have been noted, this direction cannot be called sustainable. Evaluating the level of stability of the indicators, which in many cases differ from sufficient and high and also keeping in mind low level of stability (in some cases even unacceptable) of some indicators in mid- and long- term periods is the conclusion we come to.

6. Economic crisis which began in Russia in the second half of 2008 exercised its negative influence practically on all the indicators of the social sphere having once again changed its direction from the viewpoint of sustainable and safe social and economic development of all the regions of UrFO.

The validity of the conclusions was proven (especially in the final part) by a forecast of the main indicators of the social sphere of the Sverdlovsk region for 2011. Mathematical modeling together with the economic and statistic methods were used as the basis for investigation. The indicators to be modeled are:

- real affordable capital of the population;
- level of registered unemployment.

All the indicators are given in index form and not based on quantity. To represent the data better on the analyzed indicators their monthly values were taken from 2005 till March 2009. Such a time frame, on the one hand, is sufficient enough to represent the selection (51 observations for one territory). However, on the other hand, it comprises both the period of sustainable development and growth of the Russian economy (2005 – 1st half of 2008) and the period of instability with negative trends according to many indicators (beginning from the 2nd half of 2008). The information for analysis was taken from the Federal Statistics Service.

The forecasting process of the indicators mentioned above included the following stages:

1. The original selection of the factors exercising the most influence on the modeled indicators of the social sphere. The following factors were chosen:

- average index of volume of production change in the basic types of economic activity (extraction of minerals, manufacturing industry, production and distribution of electricity, gas and water, construction industry, and services);
- average monthly US dollar/ruble exchange rate at MISEX;
- rate of inflation;
- balanced accounts financial result of activity of enterprises.

When choice of indicators was conducted it was important that there were data per month along with the forecasted results. It is for this reason that many indicators were paid no attention though they influence the state of the social sphere a lot. At the same time the chosen set of factors reflects basic macroeconomic trends and is sufficient enough make extended forecasts for the social sphere.

2. Grouping of the subjects of the Russian Federation along similar conditions of social and economic development. The sample selection is enlarged by grouping together the subjects with similar conditions and applying a uniform model to all the territories comprising the group. On the one hand, such an approach leads to territories being deprived of their unique features, but, on the other hand, more importantly it helps enlarge the size of the selected sample by the number of united territories.

To conduct grouping of the subjects from the viewpoint of indicators modeling the following features were deemed as necessary:

- climatic conditions (normally average temperatures of January and July were paid particular attention to);
- urbanization level (was considered through the share of city population in the population total);
- level of territory development and territory population (was calculated through population density).

As a result, the Sverdlovsk region appeared in the same group with Samara, Chelyabinsk and Kemerovo regions.

3. Conducting correlation analysis. Understanding the power and character of interrelations between the modeled indicator and influencing factors. The result of this stage is finalization of the choice of factors included into the models and exclusion of multicollinear relations.

An example of a correlation matrix for a modeled indicator of real available capital income of the population is provided in Table 1.

The given correlation matrix presupposes modeling of the indicator under consideration according to x_1 and x_3 .

4. Building multifactor regression models including the factors correlating with the modeled indicators in the best possible way. Check of importance of model. A computer program SPSS was used to perform this stage.

Table 1: Correlation matrix demonstrating dynamics of real available capital income of the population for a sample Samara, Sverdlovsk Chelyabinsk and Kemerovo regions

	y	x_1	x_2	x_3	x_4
y	1,000				
x_1	-0,428	1,000			
x_2	0,062	0,102	1,000		
x_3	0,439	-0,703	-0,159	1,000	
x_4	0,032	0,003	0,013	0,059	1,000

5. Model check by means of the data of a retrospective period. Excluding from the list those models which in a retrospective period deviate the modeled indicator by more than 5–7%. The ultimate result of the stage is finalization of the choice of models which may be used to make forecasts.

Designations used:

y – real available capital income of the population;

x_1 – average index of production volume according to the basic types of economic activity (TEA);

x_2 – rates of inflation;

x_3 – average monthly US dollar/ruble exchange rate at MISEX;

x_4 – balanced accounts financial result of activity of enterprises.

For example, the models finally chosen for the indicator of real available capital income of the population were the following:

$$y = 120,139 + 0,226 * x_1 - 0,337 * x_3,$$

$$y = 45,946 * LN(x_1) - 22,55 * LN(x_3).$$

6. Forming scenarios of social and economic development of the Sverdlovsk region till 2011. The basis for these scenarios are the developed scenarios of social and economic development of Russia till 2030 (worked out by the Ministry of Economic Development of Russia); modern trend in development of the country and the region (relying on the data of the Federal Statistics Service); trends of situation change at the world markets of raw materials; scenarios of social and economic development worked out by the government of the Sverdlovsk region. Three scenarios were made up - realistic, optimistic and probabilistic. The indicators of scenario development for the models chosen at stage 3 are presented in Table 2, and the forecast of development of the modeled indicators is presented in Table 3.

The results demonstrate that even according to the pessimistic scenario the dynamics of real capital income of the population in 2009 remains at the same level as at the end of 2007. It is impossible not to pay attention to the fact that economic surrounding is changing constantly and should the market situation or currency exchange rate change dramatically the models may alter as well. This may lead to some correction of the forecasted value. However as Russia is a developing country, lack of dynamics in this important indicator is regarded as a negative trend.

Data on the indicator of registered unemployment show that although there are 38000 unemployed in the Sverdlovsk region in 2007 this figure will grow by 2009 and will amount to 59000 people. This proves once again the dependence of the level of unemployment on

Table 2: Scenario indicator of social and economic development of Sverdlovsk region in the period till 2011 for the factors chosen (% to the previous year)

Factor	Realistic			Optimistic			Pessimistic		
	2009	2010	2011	2009	2010	2011	2009	2010	2011
1.Average index of production volume according to TEA	95	103	105	100	105	107	90	100	102
2.Average monthly US dollar/ruble exchange rate at MISEX	128	108	100	115	100	95	140	115	105

Table 3: Forecast of the basic indicators of social sphere in the Sverdlovsk region in the period till 2011 (% to the previous year)

Factor	Realistic			Optimistic			Pessimistic		
	2009	2010	2011	2009	2010	2011	2009	2010	2011
1.Real available capital income of the population	99	107	110	104	110	112	94	104	108
2.Registered level of unemployment	139	111	101	121	101	95	153	121	109

the level of production, trade and services. The situation currently observed at the labour market designates that companies lack capital resources, that there are problems with

redistribution of reserve funds, that such management skills as planning and forecasting are underdeveloped. It also shows that there used to work more people than it was necessary. If the amount of workers decreased twice it should designate a twice fold decrease of production or speak about personnel policy improvement. Thus the economic crisis triggered the process of human resource policy rationalization.

The results presented above have been undoubtedly extended and the list of influencing factors should be more detailed and enlarged. Furthermore, it is worth mentioning that they may be used as the basis for working out of the federal and regional policy in the field of sustainable development of the social sphere. Moreover, the suggested methodological base makes conducting the extensions if required, possible. When choosing the main direction in which research should go, attention should be paid to modeling latent characteristics and time lags so as to make it possible to construct dynamic models in future.

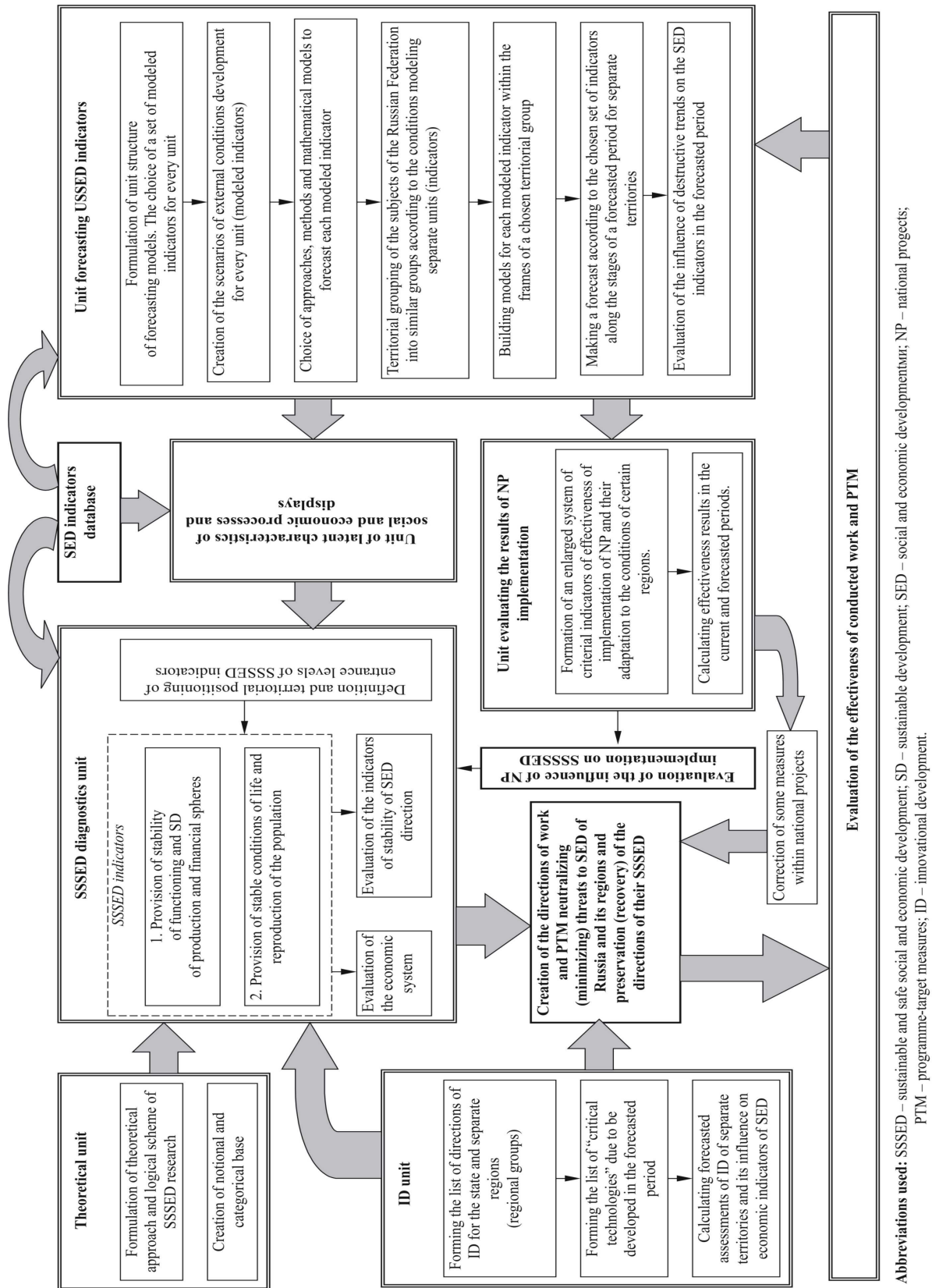


Figure 4: The scheme of research of SSSSED of the territories of different levels

References

1. Our Future. International Commission on Environment and Development. M.: Progress, 1989.
2. Strategy and Problems of Sustainable Development of Russia in the 21st Century. Eds. A.G.Granberg, V.I. Danilov–Danilyan, M.M. Tsikanov, E.S. Shopkhoev. M.: Economics, 2002. 414 p.
3. Danilov–Danilyan V.I., Losev K.S. Ecological challenge and sustainable development. M.: Progress–tradition, 2000. 416 p.
4. Hartwick J.M. Intergenerational Equity and the Investing of Rents from Exhaustible Resources. Amer. Econ. Rev. 1977. Vol. 67, No. 5. pp. 972–974.
5. Hartwick J.M. Sustaining periodic motion and maintaining capital in classical mechanics. Japan & World Economy. 2004. Vol. 16. pp. 337–358.
6. Akimova T.A., Moseikin Yu.N. Economy of sustainable development. M.: Publ. House “Economics”, 2009. 430 p.
7. Wikipedia – free encyclopedia. [electronic resource].
URL: <http://ru.wikipedia.org/wiki/ODI>.
8. Economic Safety of Russia: General Course: manual. Ed. V.K.Sentchagov. 2nd ed. M.: Delo, 2005. 896 p.
9. Economic safety. Production – Finances – Banks. Ed. V.K.Sentchagov. M.: Finanstatinform, 1998. 621 p.
10. Glazyev S. The basis of providing economic safety of the country – alternative course of reforms. Russ. Econ. J. 1997. No. 1. pp. 3–19; No. 2. pp. 3–18.
11. Economic and national safety: Manual. Ed. E.A. Oleinikov. M.: Examination, 2004. 768 p.
12. Economic safety of the region: unity of the theory, methodology of research and practice. A.I.Tatarkin, A.A.Kuklin, O.A.Romanova, V.N.Tchukanov, V.I.Yakovlev, A.A.Kozitsin. Ekaterinburg: Publ. House of the Ural State Univ., 1997. 240 p.
13. Economic safety of Sverdlovsk region. A.I.Tatarkin, A.A.Kuklin, A.L.Myzin, A.V. Kalina et al. Ekaterinburg: Publishing House of the Ural State Univ., 2003. 455 p.
14. Bogdanov I.Ya. Economic safety of Russia: theory and practice. M.: ISPI RAN, 2001. 348 p.
15. Kalina A.V., Krivorotov V.V., Vasiliev D.S. Threats to sustainable and safe social and economic development of Russia and its regions: problems, analysis and ways of solving. Vestnik USTU–UPI. Economics and Management. 2008. No. 6. pp. 51–61.
16. Nikolis G., Prigozhin I. Understanding the complicated: M.: Mir, 1990.
17. Prigozhin I., Stengers I. Order out of Chaos. New dialogue of a human with nature. M.: Editorial URSS, 2001.

18. Materials from the website of the World [Electronic resource].
URL: <http://www.worldbank.org/>
19. Report on human development 2009. Overcoming barriers: human mobility and development / PROON. M.: Whole World, 2009. 232 p.
20. Afanasiev V.N., Yuzbashev M.M. Time rows analysis and forecasting. M.: Finances and Statistics, 2001. 228 p.
21. Afanasiev V.N., Yuzbashev M.M. Ranks correlation coefficient as an indicator of dynamics stability. Vestnik statistiki. 1983. No. 11.
22. Tchetverikov N.S. Statistic and stochastic research. M.: Gosstatizdat, 1963.
23. Kasyutin A.E., Kunitsina N.N. Methods of banking system stability evaluation: collect. acad. articles State technic Univ. Northern Caucasus. Economics. 2006. No. 4.
24. Krivorotov V.V., Kalina A.V., Khmelniker E.S. Evaluation of the state and forecasts of social sphere development of the Ural Federal Okrug territories. Vestnik Orenburg state. 2009. No. 10. pp. 58–65.